Space Weather Technical Forecast

Issued on Saturday, 11 March 2023 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares (R1-R2/Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours with generally background C-class activity. The largest flare a C4.6 at 11/0100UTC from AR3245. There are currently 10 numbered sunspots on the visible disc, with AR3245 the largest showing little change in recent hours. The remaining regions are generally small or magnetically simple, and either stable or slowly evolving. The exception to this is AR3250 which continues to show some spot emergence and rudimentary umbra development. A small unnumbered unipolar region has been evident in the northeast but appears to be fading. Currently no Earth directed CMEs have been observed in available imagery, however model results are awaited for two recent fairly slow but broad CMEs observed leaving the southwest disk on the 10th.

Solar Wind / Geomagnetic Activity: The solar wind has varied from 450km/s to near 400km/s on a steady trend. Density was around or rather below average. Total magnetic field strength was weak around 5-7nT. The north-south component varied weakly between negative and positive levels. Phi angle was generally negative (towards the Sun) but with occasional periods of positive. Geomagnetic activity was Quiet to Unsettled (Kp 0-3)

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at background levels. High energy electron flux (greater than 2MeV) has varied between mainly moderate and high levels, with a peak of 1980pfu at 10/1725UTC. Electron fluence has been mostly steady following a slightly declining trend. A reading of 4.26e7 was observed at 11/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain generally Low with occasional C-class flares. But with the number of active regions on the disk there remains a chance of an isolated M-class flare, perhaps most likely from AR3245 or the developing AR3250.

Solar Wind / Geomagnetic Activity: No CMEs are currently forecast to affect the Earth in the next four days, however model results are awaited for two recent fairly slow but broad CMEs from the southwest disk which could perhaps bring glancing blows later in the period. Solar winds are expected to be at mainly slow-ambient levels over the next few days, with no further coronal hole HSS connections forecast, to give appreciable enhancements. Geomagnetic activity is likely to be mostly Quiet to Unsettled (Kp 0-3) throughout the period, with a slight chance of an Active interval.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as observed by GOES16, is currently at background levels with a slight chance of reaching S1 or greater should any larger flares occur. High energy electron flux levels (greater than 2MeV) are

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expected oscillate between moderate and high levels initially, becoming mostly background to moderate. Electron fluence is expected to continue to slowly decline and probably remain below the Active threshold.

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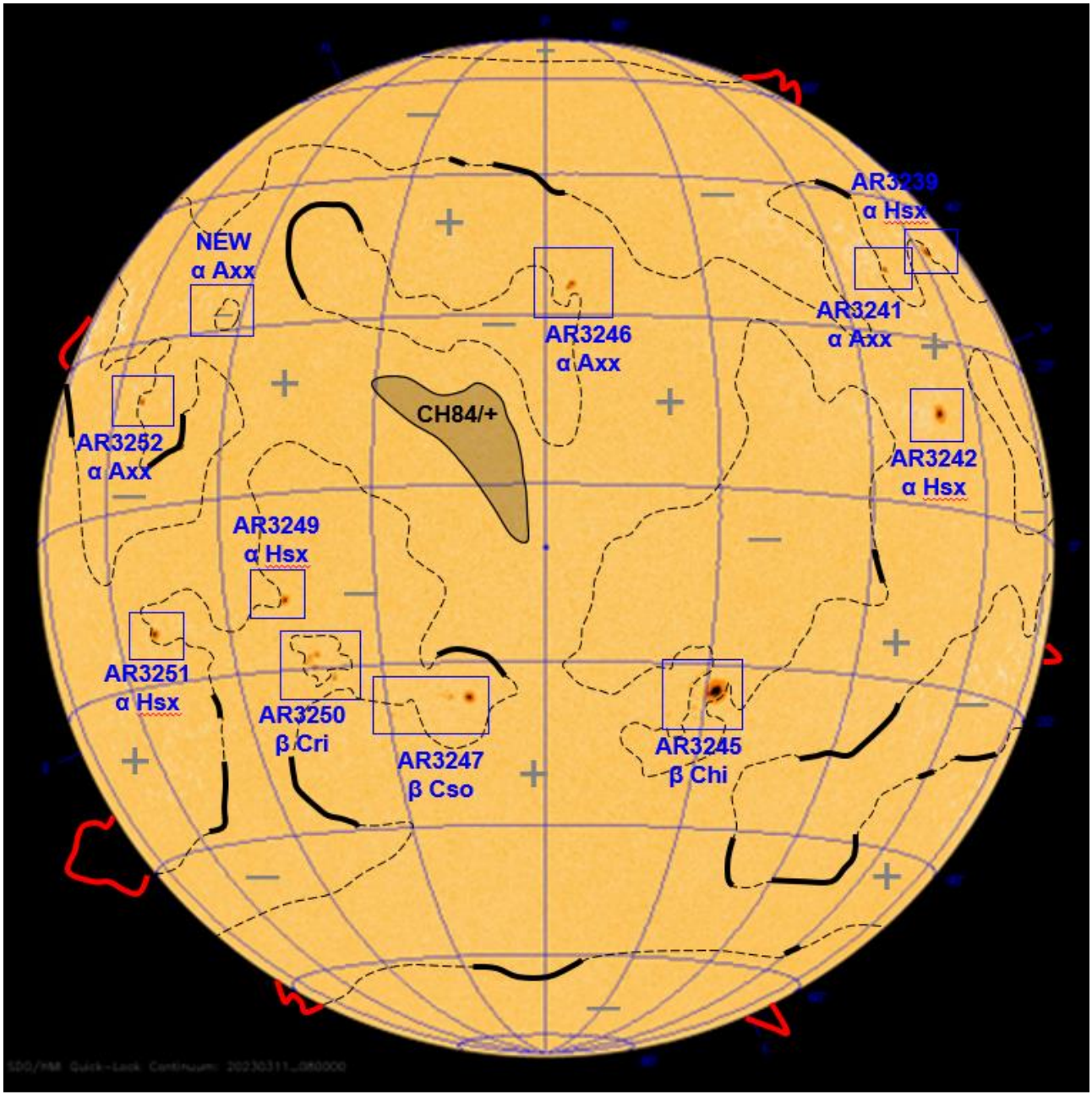
Figure 1. Solar Analysis Valid 11/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

Coronal hole influence has weakened with solar winds now nearly reaching slow-ambient levels. No further coronal holes are expected to affect the Earth through the forecast period, however positive region CH84 is due to arrive in a favorable location with a high speed stream probably reaching Earth around 15 March.

No CMEs are currently forecast to affect the Earth in the next four days, however model results are awaited for two recent fairly slow but broad CMEs associated with flare activity and a filament lift off from southwest disk on the 10th which could perhaps bring glancing blows later in the period.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of an isolated Active interval (Kp 4).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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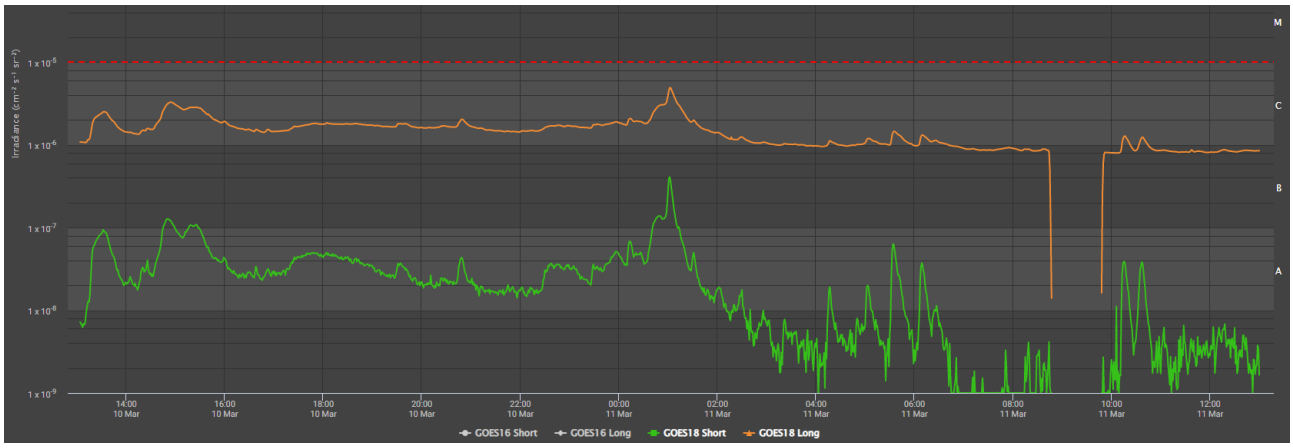
Radio Blackouts - X-Ray Flares:

There are currently 10 numbered sunspots on the visible disc and one unnumbered, though this appears to be fading. AR3245 is the largest showing little change in recent hours. The remaining regions are generally small or magnetically simple, and either stable or slowly evolving. The exception to this is AR3250 which continues to show some spot emergence and rudimentary umbra development. Some plage areas visible on the eastern limb but far side data so far shows only limited oncoming activity during the forecast period.

Solar activity is expected to remain Low with occasional C-class flares. But with the number of active regions on the disk there remains a chance of an isolated M-class flare, perhaps most likely from AR3245 or the developing AR3250.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: GOES 18 X-Ray trace for the past 24hr



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Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. AR3242 and AR3245 pose the most elevated proton risk. AR3242 is in the northwest quadrant, with AR3245 rotating across the southwest quadrant. The risk maintained at a relatively low level as both spots transit the western hemisphere towards the limb through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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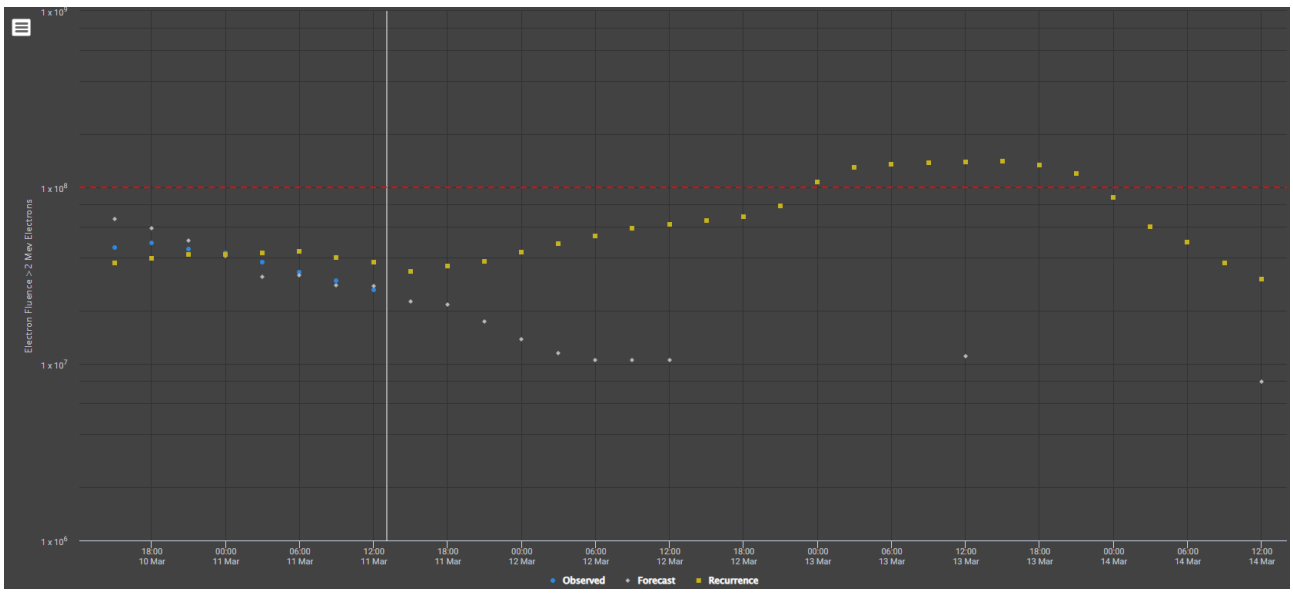
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has been at mostly moderate levels through the last 24 hours, with an incursion to high levels for a time. The long-lived high speed streams (HSS) related to coronal holes 81 and 82 have now waned. In the absence of further coronal holes and with limited geomagnetic activity, electron flux is expected to continue to follow a declining trend through the period, with peaks increasingly likely to be below the high threshold through the period. The BAS radiation belt model is suggesting high electron populations in lower Earth orbits, but with no significant geomagnetic activity forecast and solar wind speeds approaching background levels there appears to be limited mechanisms for the electrons to reach higher orbits.

Electron fluence edged further down and remains below the Active threshold. Levels will probably continue to follow a steady or gradual declining trend through the period, with no inputs or enhancements into the belts currently forecast from high speed streams or CMEs. The output from Met Office REFM is considered to be giving a good guide, and probabilities for reaching Active fluence are relatively low.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output



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